AbstractID: 11023 Title: The effect of proton therapy beam scanning pattern size on secondary neutron dose equivalent

Purpose: One way to deliver a proton therapy beam is to actively scan a uniform dose across a treatment field using a fast scanning magnet. In this study, we examine how proton therapy beam scanning patterns affect the scattered neutron dose equivalent in an active scanning proton therapy beam delivery nozzle.

Method and Materials: The nominal scanning pattern size is a 324 cm^2 rectangular pattern which projects a flat proton field of 12 x 12 cm at isocenter for a 12 cm snout size. However, it is possible to reduce the size of this scanning pattern for field sizes smaller than 12 cm and maintain beam flatness while minimizing the scattered neutron dose equivalent. Neutron measurements were taken using a SWENDI-II (Thermo Electron Corporation™) neutron detector for a treatment field defined by apertures of 10 cm and 5 cm in diameter using protons of approximately 160 MeV. In each case, the field modulation in depth was 10 cm. A Scanditronix Matrixx™ panel was used to determine field flatness.

Results: The maximum neutron dose equivalent was measured to be 0.65 mSv/Gy for the 10 cm field and 0.97 mSv/Gy for the 5 cm field 40 cm laterally from isocenter. By minimizing the rectangular scanning pattern, it was possible to reduce the secondary neutron dose equivalent by approximately 20% and 60% for the 10 cm and 5 cm diameter field sizes respectively and maintain acceptable treatment parameters.

Conclusion: The efficiency of a proton treatment beam through the final patient collimator has a large influence on the creation of unwanted secondary neutrons. Increasing this efficiency using different scanning patterns minimizes neutron dose equivalent and maintains acceptable treatment parameters for the therapeutic proton beam.